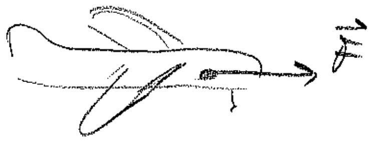
Eksamen, haust -15

Oppg. 1

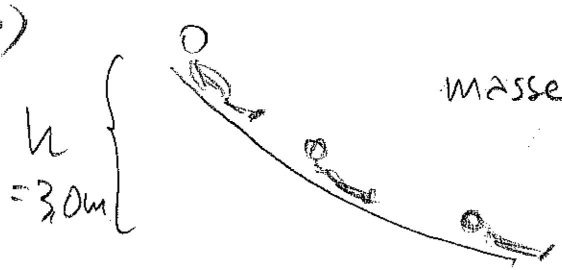


, akselerasjon a

a) Newtons andre lov:

$F = ma = 2{,}0 \cdot 10^5\ kg \cdot 3{,}5\ m/s^2 = \underline{7{,}0 \cdot 10^5\ N}$

b)



masse $m = 28\,kg$

$v = 2{,}5\ m/s$

Energi på toppen: $E_{pot} = mgh$

— " — botnen: $E_{kin} = \frac{1}{2}mv^2$

Endringa er lik friksjonsarbeidet (som vi set negativt):

$W = -(E_{pot} - E_{kin}) =$

$-m(gh - \frac{v^2}{2}) = -28\,kg \cdot (9{,}81\,m/s^2 \cdot 3{,}0\,m - \frac{(2{,}5\,m/s^2)^2}{2}) =$

$-736{,}5\ J \approx \underline{-7{,}4 \cdot 10^2\ J}$

c)

$v = 20\,km/h = \frac{20}{3{,}6}\,m/s = 5{,}556\,m/s$

masse av flaska:

$m = 0{,}50\,kg$

$r = 20\,m$

d) Veit: $R = \mu N$, $N = G = mg$

R er sentripetalkrafta her.

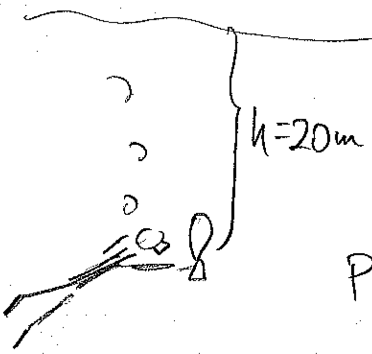
$$R = m\frac{v^2}{r}$$

$$\left.\begin{aligned} R &= \mu mg \\ R &= m\frac{v^2}{r} \end{aligned}\right\} \Rightarrow \mu mg = m\frac{v^2}{r}$$

$$\mu = \frac{v^2}{rg} = \frac{(5{,}556\,m/s)^2}{20\,m \cdot 9{,}81\,m/s^2} = 0{,}1573 \approx \underline{\underline{0{,}16}}$$

Oppg. 2

$p_0 = 1\,atm = 1{,}01 \cdot 10^5\,Pa$



$\rho_v = 1000\,kg/m^3$

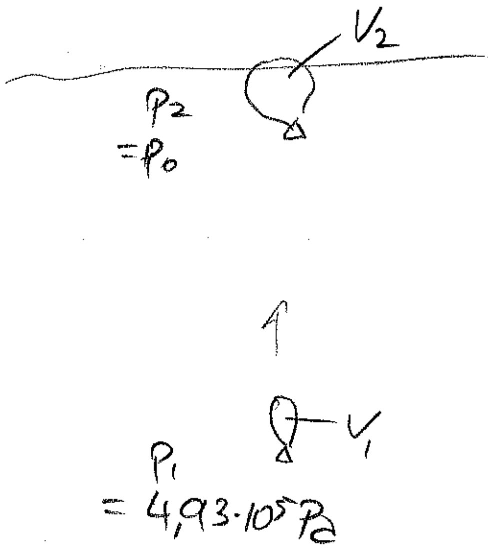
Trykk:

$$p = p_0 + \rho g h = 1{,}01 \cdot 10^5\,Pa + 1000\,\frac{kg}{m^3} \cdot 20\,m \cdot 9{,}81\,\frac{m}{s^2} =$$

$$2{,}972 \cdot 10^5\,Pa \approx \underline{\underline{3{,}0 \cdot 10^5\,Pa}}$$

b) Vi går ut frå at gassen i ballongen er ideell.

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$



$T_1 = T_2$

$$p_1 V_1 = p_2 V_2$$

$$V_2 = \frac{p_1}{p_2} V_1$$

$$= \frac{4{,}93 \cdot 10^5\,Pa}{1{,}01 \cdot 10^5\,Pa} \cdot 30\,l = 146{,}44\,l \approx \underline{\underline{0{,}15\ m^3}}$$

c) Oppdrift:

$$O = \rho V_f g = 1000\,\frac{kg}{m^3} \cdot 30 \cdot 10^{-3}\,m^3 \cdot 9{,}81\,m/s^2 =$$

$$294{,}3\,N \approx \underline{\underline{0{,}29\ kN}}$$

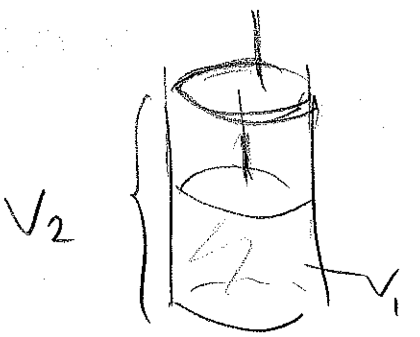
d) Endring i indre energi:

$$\Delta U = Q + W$$

der Q er mottatt varme og W er arbeid utført **på** gassen.

$$\Delta U = -4{,}0\,kJ + 8{,}0\,kJ = \underline{\underline{4{,}0\,kJ}}$$

e)



N atom

Ideell monoatomisk gass: $U = \frac{3}{2}NkT$

$\Delta U = \frac{3}{2}Nk\Delta T =$

$\frac{3}{2} \cdot 1,505 \cdot 10^{23} \cdot 1,38 \cdot 10^{-23}\,\frac{J}{K} \cdot (400 - 1150)K =$

$-2336,5\,J \approx \underline{\underline{-2,34\,kJ}}$

Oppg. 3

a)

Varme: $Q = 2,16 \cdot 10^5\,J$

Både kasserollen og vatnet får temperaturauken ΔT.

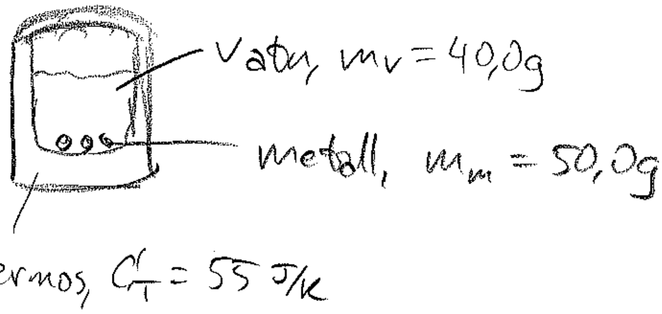
$Q = C_k \Delta T + c_v m_v \Delta T$,

der $c_v = 4180\,\frac{J}{kg \cdot K}$

$(C_k + c_v m_v)\Delta T = Q$

$\Delta T = \frac{Q}{C_k + c_v m_v} = \frac{2,16 \cdot 10^5\,J}{470\,\frac{J}{K} + 4180\,\frac{J}{kg \cdot K} \cdot 0,500\,kg} = \underline{\underline{84,4\,K}}$

b)



Starttemp., termos og vatn: $t_0 = 19{,}1°C$

— " —, metall: $t_m = 97{,}0°C$

Sluttemp.: $t_s = 25{,}0°C$

Spes. varmekap. for metall: $c_m = ?$

Varme avgitt frå metallet er lik varme mottatt av termos og vatn.

$$c_m m_m (t_m - t_s) = C_T (t_s - t_0) + c_v m_v (t_s - t_0)$$

$$c_m = \frac{(C_T + c_v m_v)(t_s - t_0)}{m_m (t_m - t_s)} =$$

$$\frac{(55\ J/K + 4180\ \frac{J}{kg \cdot K} \cdot 40{,}0 \cdot 10^{-3}\,kg)(25{,}0 - 19{,}1)K}{50{,}0 \cdot 10^{-3}\,kg \cdot (97{,}0 - 25{,}0)K} =$$

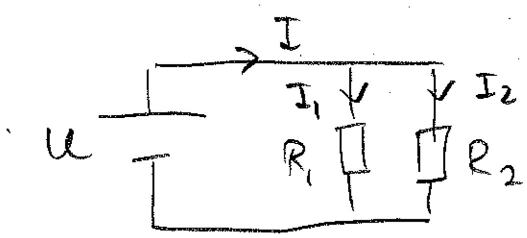
$$364{,}16\ \frac{J}{kg \cdot K} \approx \underline{\underline{364\ \frac{J}{kg \cdot K}}}$$

c) Fordampingsvarme: $Q = l_f m$, der l_f er spesifikk fordampingsvarme og m er massen.

$$m = \frac{Q}{l_f} = \frac{1{,}00\ kWh}{1{,}37 \cdot 10^6\ \frac{J}{kg}} = \frac{1{,}00 \cdot 10^3\ \frac{J}{s} \cdot 60^2\,s}{1{,}37 \cdot 10^6\ \frac{J}{kg}} =$$

$2{,}6277\ \text{kg} \approx \underline{\underline{2{,}63\ \text{kg}}}$

Oppg. 4



a) Resultantresistans: R_{res}

$$\frac{1}{R_{res}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{15\,\Omega} + \frac{1}{5{,}0\,\Omega} = \frac{4}{15\,\Omega}$$

$$R_{res} = \frac{15}{4}\,\Omega = 3{,}75\,\Omega \approx \underline{\underline{3{,}8\,\Omega}}$$

b) i) Ohms lov: $U = RI$

Her: $R = R_{res}$

$$I = \frac{U}{R_{res}} = \frac{12\,V}{3{,}75\,\Omega} = \underline{\underline{3{,}2\,A}}$$

ii) Spenninga over både R_1 og R_2 er $U = 12\,V$.

$$U = R_1 I_1 = R_2 I_2$$

$$I_1 = \frac{U}{R_1} = \frac{12\,V}{15\,\Omega} = \underline{\underline{0{,}80\,A}}$$

$$I_2 = \frac{U}{R_2} = \frac{12\,V}{5{,}0\,\Omega} = \underline{\underline{2{,}4\,A}}$$

c) Polspenning $U_p = \mathcal{E} - R_i I$ der $\mathcal{E}$ er elektomotoriske spenning og R_i er indre resistans.

Kirchhoffs andre lov:

$$\mathcal{E} - R_i I = I R_{res}$$

Går ut frå at $\mathcal{E} = 12\,V$

$$(R_i + R_{res}) I = \mathcal{E}$$

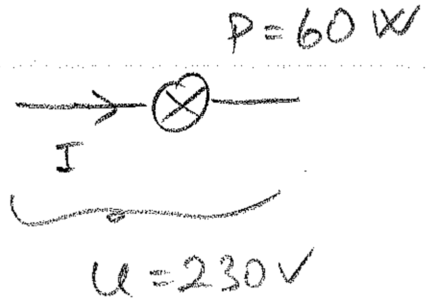
$$I = \frac{\mathcal{E}}{R_i + R_{res}}$$

$$U_p = \mathcal{E} - R_i I = \mathcal{E} - \frac{R_i \mathcal{E}}{R_i + R_{res}} =$$

$$\mathcal{E}\left(1 - \frac{R_i}{R_i + R_{res}}\right) = \mathcal{E}\,\frac{R_{res}}{R_i + R_{res}} =$$

$$12\,V \cdot \frac{3{,}75\,\Omega}{1{,}0\,\Omega + 3{,}75\,\Omega} = 9{,}474\,V \approx \underline{9{,}5\,V}$$

d)



$P = UI$

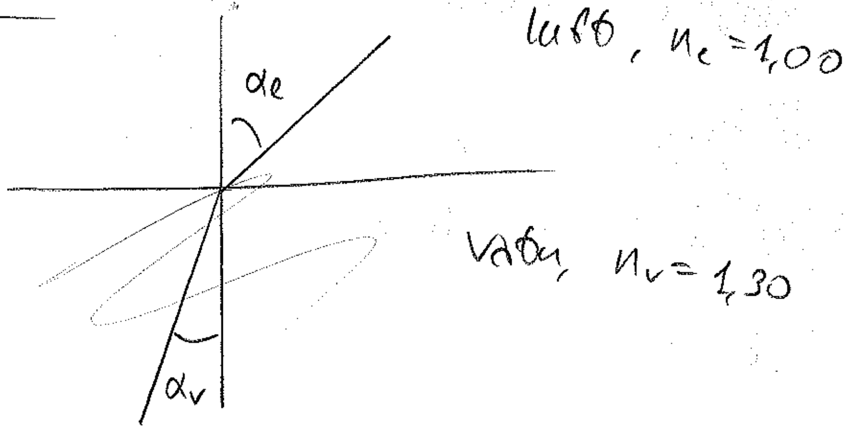
Også: $I = \frac{Q}{t}$, der Q er ladning og t er tida

$P = U\frac{Q}{t}$

$$Q = \frac{Pt}{U} = \frac{60\,\frac{J}{s} \cdot 60^2\,s}{230\,\frac{J}{C}} = 939{,}13\,C \approx \underline{\underline{939\,C}}$$

Oppg. 5a

a)



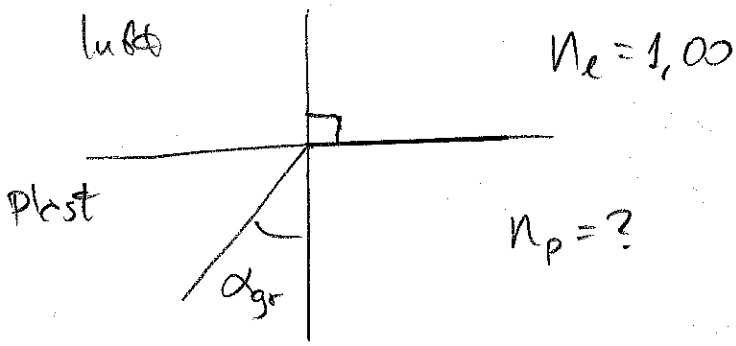
Snells brytingslov:

$$n_v \sin\alpha_v = n_l \sin\alpha_l$$

$$\sin\alpha_l = \frac{n_v}{n_l}\sin\alpha_v = \frac{1{,}30}{1{,}00}\cdot \sin 21{,}3^\circ = 0{,}47223$$

$$\alpha_l = \arcsin 0{,}47223 = 28{,}179^\circ \approx \underline{\underline{28{,}2^\circ}}$$

b)



For grensevinkelen:

$$n_p \sin\alpha_{gr} = n_l \cdot 1$$

$$n_p = \frac{n_l}{\sin\alpha_{gr}} = \frac{1{,}00}{\sin 43{,}6^\circ} = \underline{\underline{1{,}45}}$$

c) Formel for maksimum av orden n:

$d \sin \theta_n = n\lambda$

Her: $d = 3{,}2 \cdot 10^{-6}$ m

$\lambda = 560 \cdot 10^{-9}$ m

$n = 2$

$\sin \theta_2 = \frac{n\lambda}{d}$

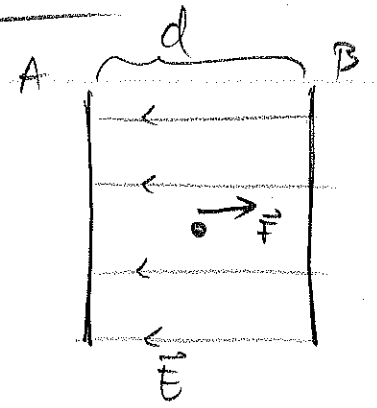
$\theta_2 = \arcsin \frac{n\lambda}{d} = \arcsin \frac{2 \cdot 560 \cdot 10^{-9}\,m}{3{,}2 \cdot 10^{-6}\,m} = 20{,}487°$

$\approx \underline{\underline{20{,}5°}}$

d) Formel: $\lambda f = c$, der f er frekvens og c er bølgefart.

$c = \lambda f = 1{,}2\,m \cdot 0{,}50\,s^{-1} = \underline{\underline{0{,}60\,m/s}}$

Oppg. 5b



a) i) Feltet peikar den retninga som krafta ville ha verka i på ein positivt ladd partikkel. For elektronet, som er negativt ladd, vil feltet peike motsett veg av krafta. Feltet peikar difor frå B til A.

ii) Feltet er gitt ved spenninga slik:

$$E = \frac{U}{d}$$

$$d = \frac{U}{E} = \frac{1300\,V}{30 \cdot 10^3 \frac{N}{C}} = 0{,}04333 \frac{\frac{Nm}{C}}{\frac{N}{C}} =$$

$43{,}33\ mm \approx \underline{43\ mm}$

b) i) Felt er kraft per ladning, $E = \frac{F}{q}$

$$|F| = |qE| = |-eE| = 1{,}6 \cdot 10^{-19} C \cdot 30 \cdot 10^3 \frac{N}{C} = \underline{4{,}8 \cdot 10^{-15} N}$$

(Retning: Mot høgre.)

ii) Newtons andre lov: $F = ma$

$$a = \frac{F}{m} = \frac{4{,}8 \cdot 10^{-15} N}{9{,}1 \cdot 10^{-31}\,kg} = 5{,}275 \cdot 10^{15}\,m/s^2 \approx \underline{5{,}3 \cdot 10^{15}\,m/s^2}$$

c) Arbeid er kraft gonger veg.

$$W = Fd = 4{,}8 \cdot 10^{-15} N \cdot 43 \cdot 10^{-3}\,m = 2{,}064 \cdot 10^{-16}\,J$$

$$\approx \underline{2{,}1 \cdot 10^{-16}\,J}$$

d) i) Startfart $v_0 = 0$

$d = \frac{1}{2}at^2$, der t er tida.

$$t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2 \cdot 43 \cdot 10^{-3}\,m}{5{,}3 \cdot 10^{15}\,m/s^2}} = 4{,}0282 \cdot 10^{-9}\,s \approx \underline{4{,}0 \cdot 10^{-9}\,s}$$

ii) Fart: $v = v_0 + at$, $v_0 = 0$

$$v = at = 5{,}3 \cdot 10^{15}\,m/s^2 \cdot 4{,}0282 \cdot 10^{-9}\,s =$$

$$2{,}1349 \cdot 10^{7}\,m/s \approx \underline{\underline{2{,}1 \cdot 10^{7}\,m/s}}$$